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Brief Communications

Intracranial Foreign Body Granuloma Mimicking Brain Tumor Recurrence: A Case Series

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Disclosures of potential conflicts of interest may be found at the end of this article.

Abstract

Background. Intracranial foreign body granuloma (FBG) is a rare inflammatory reaction to retained foreign material, manifesting acutely or months to years following neurosurgical procedures. Radiographically, FBG can mimic tumor progression, and tissue biopsy may be required to guide management.

Materials and Methods. In this retrospective case series, we present unique clinico-radiographic and histopathological features of six neuro-oncological patients diagnosed with FBG between 2007 and 2019.

Results. All six patients (4 women and 2 men, aged 29–54 [median, 30.5] years) had undergone surgical resection of a low- (n = 4) or high-grade (n = 2) glioma. FBG manifestation postsurgery ranged from 1 day to 4 years and was predominantly asymptomatic (n = 5/6). Magnetic resonance imaging universally demonstrated one or multiple peripherally enhancing lesion(s) adjacent to the resection cavity. Histopathology in all (n = 4/4) resected specimens demonstrated an inflammatory reaction to foreign material, confirming FBG.

Conclusion. Intracranial FBG constitutes a rare but challenging treatment-related condition effectively managed by surgery, with important therapeutic implications in neuro-oncology. ***The Oncologist*** 2021;26:e893–e897

Introduction

Cancer treatment-related effects remain a challenge in neuro-oncology [1]. Most patients with brain cancer receive multimodal treatment that includes maximal safe surgical resection, radiation therapy (RT), and/or systemic antineoplastic therapy. Treatment-related damage to healthy brain parenchyma may result in serious neurologic sequelae with significant diagnostic and management challenges [1].

Intracranial foreign body granuloma (FBG; aka textiloma or gossypiboma) is a rare but serious treatment-related inflammatory reaction to retained foreign material following neurosurgical procedures [2]. Intracranial FBG can occur as an acute postoperative complication or, more commonly, develop months to years after surgery [2]. FBG is a well-described iatrogenic complication in abdominal and orthopedic surgery, where it is typically caused by nonabsorbable surgical material unintentionally left in situ [2]. By contrast, intracranial FBG is considered a relatively rare phenomenon, with an estimated incidence between 0.1 –and 1 per 1,000 cranial procedures [3, 4], although the true number is likely higher as most patients may not undergo additional surgery to confirm the diagnosis. Presently, only approximately 100 cases of intracranial FBG have been reported in the literature [3]. Most appear to be caused by synthetic materials intentionally left in place, including nonabsorbable Teflon, suture, or cotton material and absorbable hemostatic material [4–6]. Similar to other types of brain cancer treatment-related effects such as pseudoprogression and treatment-induced necrosis [7], the clinico-radiographic features associated with intracranial FBG are indistinguishable from those of progressive disease (PD), making it a rare but important differential diagnosis in neuro-oncology [2, 5].

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Table 1. Clinical, radiographic, and histopathological characteristics in patients with intracranial foreign body granuloma

	Demographics ad clinical characteristics					FBG-related characteristics				
Patient	Gender	Age at Dx, years	Indication for surgery	Tumor location	Extent of tumor resection	Interval from surgery	MRI features	Clinical Sx	Management	Histopathological findings
1	F	30	Ganglioglioma, WHO grade I	L lateral ventricle	GTR	3 mo	Peripherally enhancing, diffusion restricted	-	Imaging surveillance	N/A
2	M	29	Oligodendroglioma, WHO grade II	R frontal	STR	1 d	Peripherally enhancing lesion with central diffusion restriction	-	Surgery	Extensive reactive changes including giant cell reaction, microscopic fibers visible on high power dark field microscopy
3	M	30	Oligoastrocytoma, WHO grade II	L temporal	STR	3 mo	Three peripherally enhancing nodular lesions (Fig. 1A)	-	Surgery	Exuberant giant cell reaction to foreign material. Birefringent fibers consistent with cotton (Fig. 1D, E)
4	F	54	Glioblastoma, WHO grade IV	R parieto-occipital	GTR	1 mo	Mixed solid/cystic areas with thick, nodular enhancement	+	Surgery	Giant cell reaction to weakly PAS positive nonpolarizable material; rare cotton fibers identified (Fig. 1F, G)
5	F	31	Diffuse astrocytoma, WHO grade II (progression to anaplastic astrocytoma, WHO grade III)	R frontal	STR	4 yr (from re-resection)	Ring-enhancing lesion with central diffusion restriction (Fig. 1B)	-	Surgery	Multinucleated giant cell reaction to polarizable foreign material
6	F	31	IDH-1 mutant Astrocytoma, WHO grade II	R frontal	STR	3 mo	Two nodular ring-enhancing lesions with central diffusion restriction (Fig. 1C)	-	Imaging surveillance	N/A

Abbreviations: -, absent; +, present; d, day; F, female; FBG, foreign body granuloma; GTR, gross total resection; L, left; M, male; mo, month; N/A, not applicable; PAS, periodic acid-Schiff; R, right; STR, subtotal resection; Sx, symptom; WHO, World Health Organization; yr, year.

Materials and Methods

We retrospectively analyzed six consecutive patients diagnosed with intracranial FBG following brain tumor surgery at the Massachusetts General Hospital between 2007 and 2019. This study received institutional review board approval. We highlight characteristic clinical, radiographic, and histopathological features of this rare but challenging clinical entity and discuss management considerations. Portions of this case series were previously published in abstract version [8].

Case Series

Identified patients (4 women and 2 men) were aged between 29 and 54 (median, 30.5) years at time of FBG diagnosis, and all (n = 6) had a history of intracranial surgery for a low-grade (World Health Organization [WHO] I/II; n = 4) or high-grade (WHO III/IV; n = 2) glioma (Table 1). Gross total (n = 2) or subtotal (n = 4) tumor resection was achieved in all patients. The interval between brain tumor surgery and FBG manifestation ranged from 1 day to 4 years, whereby nearly all (n = 5/6) cases of FBG were diagnosed within the first 3 months postsurgery. Notably, patient 5 had received additional antineoplastic treatment (including surgical re-resection, concurrent temozolomide-based chemo-RT, and 22 cycles of adjuvant temozolomide) prior to FBG diagnosis, given interim tumor progression from diffuse (WHO II) to anaplastic (WHO III) astrocytoma (Table 1).

Brain magnetic resonance imaging (MRI) demonstrated one (n = 4) or numerous (n = 2) peripherally enhancing lesion(s), commonly with centrally restricted diffusion (n = 4/6), located adjacent to the resection cavity (Fig. 1A – C). In nearly all patients (n = 5/6), FBG development was asymptomatic and identified incidentally during routine follow-up imaging. Patient 4 presented with acutely worsening headaches and confusion 4 weeks after initial tumor surgery, and MRI findings were concerning for PD, including cystic dilatation of the resection cavity with midline shift and new areas of enhancement. Surgical re-resection was performed given concerns of rapid tumor progression, although histopathology confirmed FBG (Fig. 1F, G).

Most patients (n = 4/6) underwent surgical removal of detected FBG lesions after a short period of imaging-based follow-up (range, 1–11 months), mainly out of concerns of interval disease progression. The remainder (n = 2/6) were conservatively monitored by imaging surveillance given

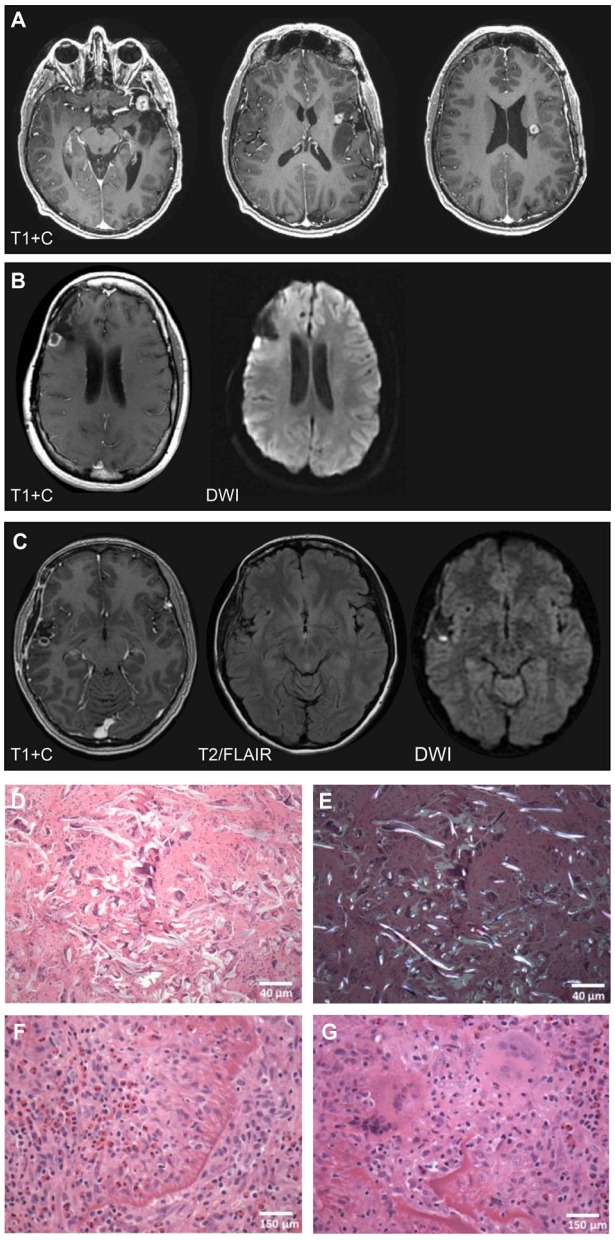

Figure 1. Magnetic resonance imaging (MRI) characteristics and histopathological findings identified in patients with intracranial foreign body granuloma. **(A):** Patient 3. Axial IR-FSPGR-BRAVO postcontrast MRI, taken 3 months postsurgery, demonstrates nodular, contrast-enhancing lesions in the left anterior temporal lobe (left panel), left insula (middle panel), and left corona radiata (right panel). Surgical resection of left temporal lesion confirmed foreign body granuloma. **(B):** Patient 5. Axial MRI, taken 4 years postsurgery, demonstrates a suspicious lesion located adjacent to the resection cavity in the right frontal lobe, characterized by peripheral enhancement on T1 postcontrast sequences and central diffusion restriction on DWI. Neuropathological evaluation of the resected lesion confirmed a multinucleated giant cell reaction to polarizable foreign material, consistent with foreign body granuloma. **(C):** Patient 6. Axial MRI, taken 3 months postsurgery, demonstrates two enhancing extraaxial nodules (one nodule shown) along the inferolateral aspect of the resection cavity in the right frontal lobe, without associated T2/FLAIR abnormalities but with centrally restricted diffusion on DWI, favored to represent postoperative foreign body granuloma. **(D, E):** Patient 3. Exuberant giant cell and histiocytic reaction to foreign material. Fibers have hollow, cylindrical profiles and birefringence under polarized light **(E)**, consistent with cotton. **(F, G):** Patient 4. Exuberant foreign body giant cell, histiocytic, and eosinophil reaction to weakly periodic acid-Schiff–positive nonpolarizable foreign material. Scale bar: 40 uM **(D, E)**, 150 uM **(F, G)**.
Abbreviations: DWI, diffusion weighted imaging; IR-FSPGR-BRAVO, Inversion-Recovery-Prepared Fast-Spoiled Gradient Recalled Brain Volume; T1 + C, contrast-enhanced T1-weighted; T2/FLAIR, T2-weighted-Fluid-Attenuated Inversion Recovery.

initial suspicion of treatment-related side effects, and with stable MRI findings over time (>1 and > 5 years from radiographic FBG diagnosis). Histopathological evaluation of resected tissue specimens universally demonstrated an extensive giant cell reaction to foreign material (n = 4/4), including birefringent fibers consistent with cotton and/or nonpolarizable material consistent with a synthetic hemostatic material (Fig. 1D – G). In all cases, diagnosis of intracranial FBG directly affected treatment, as salvage antineoplastic therapies could be successfully avoided or withheld until true disease progression.

Discussion

This case series highlights characteristic clinico-radiographic and histopathological features and management considerations in six individual patients affected by intracranial FBG, an important differential diagnosis in postsurgical neuro-oncological patients with de novo imaging findings. Correct imaging-based diagnostic differentiation of intracranial FBG from malignancy, abscess, hemorrhage, and other treatment-related conditions prior to surgery is seldom possible [2, 5, 6, 9, 10] and has only been reported in 6% of published cases [3]. Consistent with the literature, diagnosis of intracranial FBG in our series was established mostly within the first few months postsurgery [3, 4]. Brain MRI demonstrated one or multiple new lesion(s) characterized by peripheral contrast enhancement, mostly central diffusion restriction, and location adjacent to the resection cavity, mimicking PD. Second-look surgery was frequently necessary to guide management in patients with concern of possible disease progression. In all cases, histopathology suggested that FBG lesions developed in reaction to synthetic hemostatic material intentionally left in situ. This finding underscores the difficulty of mitigating intracranial FBG while ensuring adequate bleeding control in neurosurgical procedures [5, 6]. Notably, our patients were quite young (median age, 30.5 years). A recent systematic review (n = 100 cases of intracranial FBG) identified an average patient age of 42.2 years at time of FBG diagnosis [3]. Whether or not younger age may constitute a risk factor for FBG development (e.g., by virtue of a more active immune status) remains an area of future investigation.

The clinical presentation of patients with intracranial FBG is variable. Depending on time of onset postsurgery, and lesion size and location, patients may present with new or worsening neurologic signs and symptoms [3, 4]. Interestingly, nearly all our patients remained asymptomatic from the new enhancing lesion detected during routine follow-up imaging. As such asymptomatic cases may not necessarily be detected, the real incidence of intracranial FBG is likely higher [4]. Moreover, many patients may not undergo a second surgery to verify the diagnosis but proceed to adjuvant treatment under the assumption of PD. Based on our institutional experience, we conservatively estimate the incidence of intracranial FBG after craniotomy to be at least 1%. In patients with low-grade glioma and primarily nonenhancing disease that show a new enhancing nodule adjacent to the surgical cavity within weeks or months after craniotomy, FBG should be considered. Definitive diagnosis may only be possible after repeat surgery or with stable imaging findings over a prolonged time.

The presented series underscores that intracranial FBG can be reliably diagnosed and effectively managed by surgical resection, with the important advantage of achieving timely and biopsy-based therapeutic decisions in neuro-oncological patients. Alternatively, in cases in which lesions remain asymptomatic and stable (e.g., patients 1 and 6 in our series), ongoing monitoring appears reasonable to avoid unnecessary treatment, given the assumption that true PD may likely worsen with repeat imaging.

Conclusion

Intracranial FBG constitutes a rare but likely underreported and diagnostically challenging treatment-related condition, typically encountered within weeks to months following brain tumor surgery. Affected patients present with characteristic imaging features that mimic PD and may be associated with clinical symptoms. Surgical resection is frequently necessary for definite diagnosis and treatment of intracranial FBG. Recognition of this clinical entity is paramount for adequate patient management in neuro-oncology.

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